

automobile exhaust may be as much as 5,000 times greater than the EPA standard.

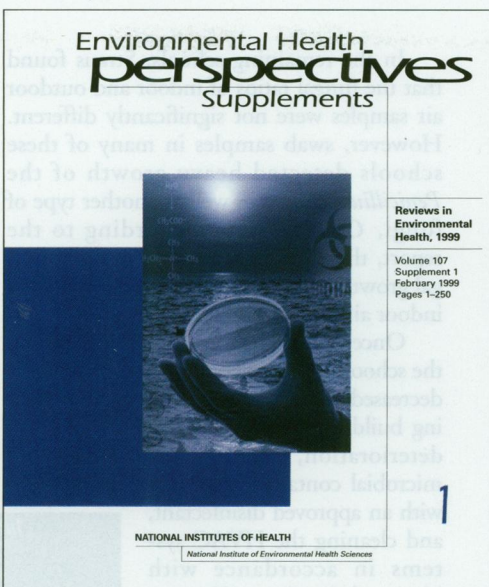
While the Cornell paper paints a discouraging picture of life on earth today, Pimentel hopes some good will come of the bad news. "We hope that our study will encourage more up-to-date reporting on diseases," he says.

Annual Review of the Environment

The association between nonionizing radiation and breast cancer, the human health implications of phenolic compounds in plants, and the impact of global climate change are among the environmental health issues given in-depth treatment in the annual review issue of *EHP Supplements*, the sister publication to *EHP*. This year's review issue, due out this month, contains 17 original peer-reviewed monographs on some of the past year's most pressing environmental health topics. Each review article contains extensive background information, as well as an author summary and analysis of the newest developments in the field.

For the 1999 review issue, Leeka I. Kheifets of the Electric Power Research Institute in Palo Alto, California, and C. Chantal Matkin of Stanford University in California examine the association between nonionizing radiation (electric and magnetic fields, or EMFs) and breast cancer. Because breast cancer occurs more often in industrialized countries, some researchers have theorized that it may be attributable to the increased use of electric power. Kheifets and Matkin assess more than 35 residential and occupational epidemiological studies that investigated the association between EMFs and breast cancer. Although most of the data do not unequivocally support an association between EMFs and breast cancer, the scientists point to the limited statistical power of the studies, as well as the possibility of misclassification and bias present in much of the existing data, as reasons why such an association should not yet be ruled out. "Given the ubiquitous nature of EMF exposure and the high incidence of breast cancer," they write, "even a small risk will potentially have a substantial public health impact." This review comes on the heels of the Working Group Report, funded by the NIEHS Electric and Magnetic Fields Research and Public Information Dissemination Program, that ruled that EMFs may be considered possibly carcinogenic to humans.

Otto Daniel and colleagues from the Swiss Federal Office of Public Health and the Swiss Federal Institute of Technology, both in Zürich, study the toxic and bene-



ficial human health effects of certain phenolic compounds. These compounds are produced in plants to serve a number of purposes, including repelling herbivores, pigmentation, protection against UV light, and biocidal defense against bacteria and fungi. External stimuli such as chemical stress from heavy metals and pesticides can alter the chemical composition or quantities of phenolic compounds in a plant; depending on its concentration, chemical structure, and any external modulation, a given phenolic compound might be either toxic or beneficial to humans. The scientists examined three such compounds. Resveratrol, which is found in grapes and peanuts, has been found to inhibit the synthesis of substances that cause blood clotting, possibly offering protection against heart disease and thrombosis. Flavonoids, which are found in almost every food or beverage of plant origin, act as antioxidants, inhibit blood coagulation, promote vasodilation, and have anti-inflammatory effects—benefits that appear to outweigh their variable mutagenic properties. Furanocoumarins, which are found in plants such as limes and celery, can cause phototoxic burns but have also been harnessed for use in psoralen UVA therapy, which is used to treat skin conditions such as psoriasis and cutaneous T-cell lymphoma.

Janice Longstreth of the Waste Policy Institute in Washington, DC, and the Institute for Global Risk Research in Bethesda, Maryland, discusses the regional impact of global climate change in the United States. She says that many public health officials feel that any increases in health effects related to global climate change will be easily absorbed by the health care systems in place, but

Longstreth warns that this position may be dangerously shortsighted. She discusses the possible effects of higher temperatures, increases in ground-level ozone and other air pollutants, changes in vector, host, and infectious agent habitats, rising water temperatures, and increases in extreme events such as hurricanes and tornadoes. She also discusses how such changes may vary among regions, possibly burdening some areas more than others with a shortfall between health care needs and resources.

A second public health paper in the review issue looks at methods for maintaining control of pathogens in drinking water while simultaneously ensuring that disinfection by-products do not present health risks. Other papers cover cellular mechanisms such as the known signal transduction pathways that regulate cell cycle progression and DNA stability mechanisms, the relationship between toxic environmental chemicals and apoptosis, the manner in which metabolic genotypes affect individual susceptibility to cancer, and the role of the *Bcl-2* gene family in prostate cancer. Four papers address the roles of cholinesterases and acetylcholine in the developing nervous system, and others discuss current issues in toxicology, including the development of short-term estrogenicity tests for identifying hormone disruptors, the toxicology and chemistry of toxaphene compounds, the field of geographic modeling and its role in environmental epidemiology studies, and the latest data on waterborne diseases caused by bacterial, protozoal, and viral pathogens.

EHP Supplements is published six times each year (including the annual review issue). More information is available on the Environmental Health Information Service Web site at <http://ehis.niehs.nih.gov>.

The Source of Sick Buildings

Indoor fungal contamination has been shown to produce allergies in building occupants. While fungi have also been suspected of playing a role in sick building syndrome (SBS), a health condition that results from poor indoor air quality, few studies to date have been able to verify this link. A recent study, however, links SBS with elevated indoor levels of the fungi *Penicillium* and *Stachybotrys*, both of which have been implicated in respiratory diseases such as asthma and pulmonary hemosiderosis. The research, which was published in the September 1998 issue of *Occupational and Environmental Medicine*, is the most comprehensive SBS

study to date, having examined more buildings than any previous study.

David Straus and colleagues at Texas Tech University Health Sciences Center in Lubbock conducted a 22-month in-depth study of 48 schools that had reported concerns about health and indoor air quality to the indoor air quality company with which the university researchers are affiliated. The schools are located along the Gulf of Mexico and the Atlantic seaboard of the United States.

The researchers disseminated a questionnaire to the staff of the schools asking about health complaints, timing patterns of symptoms, and particular areas of the schools in which staff members experienced symptoms. About 30% of all staff reported symptoms or complaints, most commonly nasal drainage, congestion, and itchy, watery eyes. Most of the staff said they experienced these symptoms only while in the building. More than half of those who reported symptoms also noted increased incidences of respiratory infections such as tonsillitis, bronchitis, and, in some cases, pneumonia.

The researchers also measured humidity, particulate matter, carbon dioxide, and chemicals such as formaldehyde, nitrogen dioxide, hydrogen sulfide, sulfur dioxide, and carbon monoxide, both indoors and in the outdoor areas surrounding the schools. They examined the schools' heating, ventilation, and air conditioning (HVAC) systems, and took swab samples and air samples at sites that had been wetted and showed mold growth.

In some of the schools, Straus's team discovered that the major factor that correlated with the health complaints was increased indoor levels of *Penicillium* and *Stachybotrys*. Straus says that, ideally, the amount of fungi inside a building should be much lower than that outside. In many of the schools, the levels of the two fungi were much higher inside than outside. These schools were found to conduct very little HVAC maintenance and many had active water leaks, creating the damp conditions in which fungi thrive.

Twenty schools showed significant increases in the amounts of *Penicillium* species in indoor air samples of complaint areas. The mean indoor relative humidity in these areas was higher than in noncomplaint areas and higher than outdoor relative humidity. At 11 schools, the researchers found heavy growth of *Stachybotrys* molds on swabs taken from under damp carpets and vinyl wall coverings and on walls. This organism produces a mycotoxin that has been shown to affect the central nervous system and cause damage throughout the body.

In the remaining schools, Straus found that the fungal ratios of indoor and outdoor air samples were not significantly different. However, swab samples in many of these schools detected heavy growth of the *Penicillium* species as well as another type of fungi, *Cladosporium*. According to the report, these findings indicate possible fungal growth inside the schools and a potential indoor air quality problem.

Once remedial action was completed in the schools, the number of health complaints decreased. Remedial action involved replacing building materials that showed physical deterioration, cleaning surfaces showing microbial contamination and treating them with an approved disinfectant, and cleaning the HVAC systems in accordance with National Air Duct Cleaners Association standards. The researchers followed up with air and swab samples within 60 days of the cleaning and again six months later. They found that fungal ratios had returned to acceptable, normal levels, and that the percentage of staff complaining of symptoms had dropped from 30% to less than 3%.

To prevent fungal contamination, Straus says, the solution is very simple: "Get water out of the building and properly maintain the HVAC system." He says that building maintenance is also important because problems such as roof leaks and broken pipes also increase humidity, allowing fungi to thrive.

Straus says the team did not disseminate the surveys to students due to the difficulty of administering them to children and the unreliability of children's responses. He says, however, "We believe that children are affected even more [by the fungi] because they are still growing." While research on the effects of fungi on children's health is sparse, a 1993 case in which experts believed that a strain of *Stachybotrys* caused adverse health effects in many infants spurred public interest. Several babies in the Cleveland, Ohio, area who were found to have been exposed to the fungus developed pulmonary hemosiderosis. This disease is marked by bleeding of the lungs—which can lead to coughing up blood, nose bleeds, chronic cough and congestion, and anemia—and caused the death of many of the infants.

BCTP Sounds Its Battle Cry

A newly developed antimicrobial agent known as BCTP may offer scientists a powerful weapon against a range of viruses, spores, and bacteria, including the culprits behind two of the deadliest diseases known to humans—anthrax and influenza. BCTP has been shown to kill up to 90% of anthrax spores in mice and 99.6% of influenza A virus in *in vitro* tests. These findings were presented at the 38th Interscience Conference on Antimicrobial Agents and Chemotherapy, held 24–27 September 1998 in San Diego, California.

Anthrax is caused by the bacterium *Bacillus anthracis*. It is generally a disease of four-legged animals, but can spread to humans in three ways. Cutaneous infection occurs through handling the hides and wool of infected animals, and is characterized by skin ulcers and swelling of the lymph glands. This form can be fatal if not treated with antibiotics. Respiratory infection is caused by inhaling *B. anthracis* spores, which causes severe respiratory distress and shock and almost always results in death. Gastrointestinal infection occurs through eating the undercooked meat of infected animals. This form causes

severe inflammation of the gastrointestinal tract, nausea, vomiting of blood, and diarrhea, and results in death in 25–60% of cases. While anthrax infection usually occurs in agricultural regions, the spores are also part of the biological weaponry arsenals of a few nations.

Influenza A is responsible for most of the severe flu epidemics that occur worldwide each winter. The 1918–1919 epidemic of Spanish flu, which caused 20 million deaths worldwide, and the 1957–1958 run of Asian flu, which resulted in 70,000 deaths in the United States, were both strains of influenza A.

Bacterial spores are notoriously difficult to fight because the hardness of their casings makes them invulnerable to typical antimicrobial agents. But with just a few simple ingredients, BCTP slices through that Gordian knot. Soybean oil and water form an emulsion of tiny lipid droplets that fuse with the anthrax spore, causing it to revert to its active—and therefore softer and more vulnerable—bacterial state. This makes the spore sensitive to disruption by the detergent Triton X-100

